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pond in a field near the north side of an east and west road, and about one mile east of Pilot Knob hill. The pond was dry on this date, but the species is submerged in this pond the greater part of the year. This species proved to be *Isoetes Braunii* Durieu. Both species of *Isoetes* were determined by Prof. L. S. Hopkins. Specimens of the species of ferns and quillworts mentioned in this paper have been distributed among the larger herbaria of the United States.

BLUFFTON, INDIANA.

Experiences with a Fern Garden—II

C. L. GRUBER

In August, 1911, a magnificent specimen of the common brake, four feet high, was brought home and planted in the yard along a wire-netting fence. On account of its weedlike propensities I did not trust it in the fern bed. In 1912 it sent up eight fronds, but none half so high as the one I planted; but in 1913, when more than thirty-five fronds were produced, a number were nearly as tall as the original one. I set a barrier of boards, ten inches wide, into the ground to confine the ferns within a given space, but some rootstocks dived beneath the boards and sent up fronds six inches to four feet away, several coming up out of a bank eighteen inches above the level of the area in which I had attempted to inclose them. The bracken usually begins to grow during the last week in April. Practically all the fronds are fertile and the brown sporangia ripen from the middle of June till into September.

From a station thirty miles away I brought three plants of the purple-stemmed cliff brake and set them in my fern garden in August, 1911. I planted one of them in the open ordinary soil, another at the base of

the rock pile, and the third among some flat pieces of flaky limestone. The third one alone seemed to be planted in soil adapted to its needs. The plant set in the ordinary soil, away from stones, a vigorous specimen, died in 1912, the one at the base of the rock pile failed to appear in 1913, but the other, set among limestones, grew finely till 1916, when, after producing a half-dozen fine fronds, it began to decline and was dead by the middle of summer. The first fronds of spring appeared from April 25 to May 10 and the dark brown to shiny black sporangia ripened during the second half of June. The first fronds are practically all fertile, but those appearing late in June or early in July are sterile or only partly fertile. On upright fronds the pinnae usually stand in a horizontal position.

In June, 1911, I selected two obtuse woodsias from among dozens growing on a rocky bank, for my fern garden and planted them in the ordinary soil of the garden. They thrived wonderfully in their new home, producing more and finer fronds than in the wild state. On their native rocks, exposed to the sun for at least half of the day, the ferns were rather slender, more or less decumbent, and yellow-green, but on my fern bed most of them were strong, erect, and bluish green, and one peculiarity was that they were much more hairy than their former companions growing on the ledges. The woodsias are among the first to appear in spring, sometimes appearing as early as March 25 and never delaying their coming beyond the middle of April. Practically all the fronds are fertile and the brown sporangia continue to ripen on successive fronds from about the 5th of June till into September. I have good evidence that some ferns die of old age. One of the obtuse woodsias, a strong plant, multiplied and spread outward so rapidly that its root base measured over seven inches in diameter by the close of 1913. In the

spring of 1914 the central portion was dead, but the new growth formed a circle of fronds around it. In 1915 only a few weak fronds appeared. By transplanting some of the young growth of 1914, I soon had a new clump of thrifty woodsias. In the case of several species of ferns, this method of transplanting appears to be the best plan for keeping the fern garden stocked with typical specimens. In 1914 I noticed a tiny fern outside the fern bed, in a slightly moss-grown place. This proved later to be a seedling woodsia, the first fern to grow from the spores of my garden, and in 1916 I gave it a place in the bed where it promptly sent up typical woodsia fronds.

I have had difficulty in growing rattlesnake ferns. I planted one in 1911 and two in 1912, but all failed to appear the second year after they were planted. In 1914 I again planted two of these ferns and they were still growing in 1916. The new growth appeared in spring from April 26 to May 5; but when they fruited at all they fruited so poorly that no reliable record could be kept of the ripening of their yellow sporangia.

If their rights are properly respected, the grape ferns are easily cultivated. During 1911 and 1912 I planted five grape ferns; but when I dug up the fern bed in 1913 I evidently disturbed their roots unduly, an unfortunate occurrence which all except one resented by dying. The one exception lay dormant during 1914 and again appeared in 1915. In September, 1914, I planted two grape ferns of the *obliquum* type, two of the *dissectum* type, and one intermediate between them. I now have five growing grape ferns, mostly thrifty plants. In 1916, four of them fruited and one, the *dissectum* of 1912, produced two sterile fronds in addition to a fine fertile frond. The bronzed sterile fronds of 1915 remained as late as the first or second week in August, 1916, and at the beginning of August they were still

living but withering and becoming blotched with black. The young fronds appeared, both sterile and fertile at the same time, on dates varying from June 20 to July 10 and rather regularly distributed between them, except one very late one which appeared on July 22; and the yellow sporangia ripen from September 15 to September 25.

No ferns respond more readily to cultivation than the Christmas ferns. In August, 1912, I planted two of these ferns of the common type, one of the *crispum* form, and one of the *incisum* form, and all grow satisfactorily. The new fronds commonly appear in spring from April 12 to April 24. Most of the first fronds are fertile and the orange-brown spore cases ripen commonly during the first week in June although on some fronds they do not ripen till the middle of June. The spores of the variety *crispum* seem to come to maturity a few days earlier, my record for three successive years giving the date as May 30. After the spores are shed the persistent indusium frequently has the shape of an inverted square pyramid. Sterile fronds appear from the middle of June to the beginning of August.

Two dwarf spleenworts were transferred to my fern garden in July, 1911. One, planted in ordinary soil away from stones, was dead in the spring of 1914; the other, set in a crevice of the rock pile, has developed into a fine specimen and sends up an increasing number of fronds each year. In 1913 a few fronds began growing on April 12, but the usual time for them to appear is the first week in May. The rich brown sporangia ripen about the third week in June. The first fronds are practically all fertile and fruiting fronds continue to appear as late as July, the sterile fronds, usually not numerous, appearing late in June and in July.

The ebony spleenwort has so far disappointed me. From 1911 to 1914 I planted seven of these pretty

ferns and by 1916 every one of them was dead. During the two or three years of their life they produced a few short fertile fronds and a few sterile fronds. The data concerning their growth were consequently unreliable; but those concerning the dwarf spleenwort seem to fit the ebony spleenwort exactly.

Cultivated or wild, the lady fern is a vigorous grower; and it seems to me as if the plant in cultivation increases the spread of its rootstocks more rapidly and produces more numerous fronds than it does when growing wild. In May, 1911, I planted two of these ferns in my fern bed, one of the regular type and one of the red-stemmed variety; and in August, 1912, I planted a form with broader and more leafy fronds. All are growing vigorously, the red-stemmed form, especially, having produced a dense mass of rootstocks bulging several inches above the surface. The extreme dates when these ferns began to grow in spring are April 17 and May 1, but the usual time for their appearance is April 24. I also planted one red-stemmed lady fern in ordinary soil along a fence and it thrives as well as those on the bed. The first fronds are sterile or only partly fertile, the fertile fronds appearing from two to four weeks later. The leafy-fronded form seems to produce a smaller percentage of fertile fronds than the others. In 1914 a rather severe drought prevailed during May and the beginning of June, but toward the middle of June wet weather set in and most of the ferns responded to the welcome change by producing new fronds. This was especially noticeable in the lady ferns, large numbers of fertile fronds appearing during the latter half of June. The light brown to brown sporangia, dark brown to nearly black on the red-stemmed form, begin to ripen by the end of June, rarely by the middle of June, and fronds with ripening fruit may often be found as late as August. The pale young fruit dots give the back of the frond a slightly silvery appearance.

In May, 1911, I planted two silvery spleenworts, one along a fence in open sunlight, the other on the fern bed, in partial shade. Both are growing fairly well, but it is a peculiar fact that the fern along the fence, which by this time has formed an elevated circular mass of strong rootstocks, thrives better and produces larger fronds and a greater number of fertile fronds than the one on the fern bed. Neither of them, however, equals the fern in its wild state. The difference in texture of the fronds and in color, yellow-green in the sunlight, green or blue-green in the shade, is quite noticeable in my two plants. The young fronds appear from April 24 to May 6. The first fronds are sterile, the fertile fronds appearing about the middle of June and in July. The young fruit dots are prominent and give the under side of the frond a silvery appearance. The sporangia begin to ripen during the latter part of July and continue to mature on successive fronds till September; but long before the sori open the dark brown sporangia are visible through the pale green or whitish, thick and fleshy, transparent indusium.

For some time the polypody refused to appreciate the care I bestowed upon it; but I now have three clumps of these ferns growing, two between stones of the rock pile and one in the ordinary soil of the fern bed partially shaded by the overhanging fronds of the interrupted fern. The first fronds are mostly fertile and begin growing from April 19 to April 26, the sterile fronds appearing during June. The lemon to dark orange sori, thick, cushiony buttons, ripen their orange to orange-brown sporangia during the latter part of July and the beginning of August.

The beech fern, like the bracken, is addicted more or less to roving habits. In July, 1911, I planted a rootstock containing a few fronds of the broad beech fern. It took kindly to its new home in the fern bed, wandering hither and thither among the other ferns, and, when

crowded by their overhanging fronds, rose to the occasion, lengthened its stipes, and lifted its triangular fronds above the shoulders of its jostling neighbors. The young fronds began to grow late in April or early in May, most of the earliest ones being sterile, and in some years fertile fronds appeared as late as August. The light brown to brown spore cases begin to ripen about or soon after the middle of July and ripe sporangia may be found on some fronds as late as September.

The earliest of the ferns in my garden is the fragile bladder fern. The young fronds appear during the first days of April; and one of my notes of March 27, 1913, states that the crosiers were coming at that time, their green heads beginning to uncoil. In 1915 they began to grow on April 5, but grew very slowly till April 10, when a warm shower, raining at intervals during the night, produced a growth of a full inch till the next morning. Some of the fronds are almost fully grown by the end of April. The first fronds are generally fertile and sterile and fertile fronds continue to appear during June and July. The two plants, brought from a wet place among stones and set in my fern bed in July, 1912, have developed into two beautiful masses of ferns. The black or black-brown sporangia ripen on the earliest fronds by the close of May.

In September, 1910, I brought the rootstocks of two bulb-bearing bladder ferns from a station thirty miles away, the nearest one known, placed them in soil in a box dug into the ground for the winter, and planted them in my fern bed in May, 1911. They thrived splendidly, sending up numbers of their beautiful, slender fronds, and so many young ferns are growing from the fallen bulblets as actually to become a weed in the fern bed, forming a dense stand and crowding out almost everything else. They almost succeeded, in fact, in choking a spinulose shield fern; and I find it

necessary to remove numbers of them each year. Several of these I transplanted to a favorable habitat about two miles away and now have some fine ferns growing there. The old clumps follow the habit of the obtuse woodsia by dying outwards from the middle and producing some fronds a year or two longer on the outer circle. The fronds of the young plants usually begin to appear soon after the middle of April and those of the old plants about the close of April. One year, however, the first fronds were out on April 7. A large percentage of the fronds are fertile. The black or black-brown sporangia ripen during the last week in June and mature fruit may sometimes be found on succeeding fronds as late as September. The bulblets begin forming as early as the middle of May and some are falling by the middle of July. During July and August I have found bulblets, still clinging to the fronds, which had sprouted to a length of one-half to three-fourths of an inch.

KUTZTOWN, PA.

(To be concluded)

Notes and News

LYCOPodium SELAGO VAR. MIYOSHIANUM IN NORTH AMERICA.—Since *Lycopodium Selago* var. *Miyoshianum* does not seem to have been recorded from North America, it will not be out of place to state its synonymy and its diagnostic characters.

LYCOPodium SELAGO L., var. MIYOSHIANUM Makino, Bot. Mag. Tokyo xvi. 199 (1902); *L. chinense* Christ, Nuovo Giornale Bot. Italiano iv. 101 (1897); *L. Miyoshianum* Makino, Bot. Mag. Tokyo xii. 36 (1898). Leaves densely crowded, "ascending or spreading in the upper and mostly reflexed in the lower portion of the stem, narrowly linear, 4–6.5 mm. long, 0.5–0.6 mm wide, a little curved upwards, entire, gradually acuminate with a fine point, sessile, . . . the upper surface